INTEGRATION AND IMPLEMENTATION OF WEB SIMULATORS IN EXPERIMENTAL e-LEARNING: AN APPLICATION FOR CAPACITY AUCTIONS

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ABSTRACT
Experimental teaching in general, and simulation in particular, have primarily been used in lecture rooms but in the future must also be adapted to e-learning. The integration of web simulators into virtual learning environments, coupled with specific supporting video documentation and the use of videoconference tools, results in robust architectures that favour interactive online learning process. An implementation of a proposed framework for the capacity auction gas market is presented for validation purposes. *econport* (web simulator) is particularized and linked to WebCT (virtual environment) to conduct an e-experiment, previously part of a classroom lecture, with online social science students. Online students declared a high degree of satisfaction with the whole e-learning process and the acquisition of a certain traditional classroom lecture atmosphere.

1. INTRODUCTION

Games and simulation resources are well established features in education. Indeed, the tradition dates from more than 60 years ago in teaching experimental economics (Chamberlin, 1948) and now represents a developed body of knowledge in the teaching environment.

The aim of this practice is for students to obtain better comprehension by playing a role in the decision-making process in a “real environment” (Francis & Byrne, 1999; Oberhofer, 1999), despite the cost that an appropriate game design involves in terms of effort and time.

In order to ensure sufficient interest in the activity, it is important to provide students with some form of “real world” where they can act as principal agents, achieving a deeper understanding of their own and others’ views (Freeman & Capper, 1998). However, if they see simulation and role playing as a break from “real” teaching, the activity does not meet the target for which it was designed. The same could be said of an “unrealistic” approach. For a simulation to be realistic, it must first imitate how the real world works in practice and how it produces understandable outcomes (Bartlett & Amsler, 1979). Also, students should feel more comfortable when playing a role (Holt, 1999; Lowry, 1999).

Computer simulation has become a powerful ally for representing complex theoretical knowledge in a model. It also enables us to study the application of individual or collective decisions and actions regarding the theoretical model (Liu, Cheng & Huang, 2011). This double consideration, in the field of Social Sciences, indicates that computer simulation provides an experimental environment where researchers are able to closely scrutinize the link between a structure or causal relation, crystallized in a theory, and the behaviour that the theory postulates (Mollona, 2008). Indeed, simulation programs and research have been widely used not only in education processes but also in firms’ strategy and marketing plans (Gavetti, Levintthal & Rivkin, 2005; Gary, 2005; Otamendi & Doncel, 2011). There is therefore a general idea that simulation and games seem to make the learning process more efficient (Lowry, 1999; Akinsola & Animasahun, 2007), or at least reduce learning time (Allessi & Trollip, 2001).

However, some weakness have also been reported in terms of insufficient understanding due to simplification (Alden, 1999), or to failing to take the game seriously (Oberhofer, 1999). Even more important in this context are the limitations to the use of simulation for online teaching.

Information and Communication Technologies (ICT) have also facilitated not only students’ acquisition of important cognitive skills required for analysis (Lim & Barnes, 2005), but also represent a user-friendly and relatively inexpensive method of developing, implementing and sharing interactive pedagogy for instructors (Chen, Hwang & Wang, 2012; Kukulska-Hulme, 2012). The development of Virtual Learning Environments, such as WebCT, has promoted the use and design of games and simulation resources (Ip, Linser & Naidu, 2001), helping students to build better ideas and comments in role play circumstances without the fear of appearing foolish in front of peers (Freeman & Capper, 1998). Nonetheless, despite the positive effects of web tools,

interfaces and technology on learning, the practice and effective results of the application of these new technologies for teachers and students are still a debated subject (Selwin, 2007; Dillenbourg, 2008 or Shih, Huang, Hsu & Chen, 2012).

In sum, simulators have been widely used in recent years in classroom teaching (Rutten, Van Jooloingen & Van der Veen, 2012), and are starting to be used in online sessions. It would be very beneficial to include these web simulators in virtual campuses. We pursue specific platforms in Virtual Learning Environments for online students, which require different educational approaches to generate knowledge. These environments were, however, designed to be used in traditional teaching and not in a virtual simulation environment (Neo, Neo & Tan, 2012). Experimental teaching suffers when trying to use these platforms. Therefore, the use of simulators or demos is on the increase, and research is required to use them in virtual campuses and traditional online teaching.

In this context, the research that we propose in this paper seeks an efficient and effective merger between simulation and web tools to develop an integrated platform to teach experimental economics online. We therefore focus on the following questions:

- Is it feasible to integrate a web simulator into a Virtual Learning Environment with a classroom atmosphere?
- Is it feasible to develop a framework to experimentally teach ubiquitously but as close to a classroom lecture as possible?

Moreover, in order to create a realistic simulation for students in which they see their activity as similar to that of the real world (Barlett & Amsler, 1979; Lowry, 1999), we validate the proposed integration through the development of an experiment simulating an auction of rights to offload ships carrying Liquefied Natural Gas (LNG) into harbours.

Section 2 is devoted to describing the technological tools used and their integration, while in Section 3 the implementation for capacity auctions is addressed. An analysis of the e-experiment is provided in Section 4 and Section 5 contains our conclusions and references to future lines of research.

2. THE INTEGRATED E-LEARNING FRAMEWORK

Our aim is to experimentally teach online using web simulators as if we were teaching in the classroom. The positive characteristics of classroom teaching, like interactivity, nearness or complete visual contact, should be incorporated into online teaching (Marchand & Gutierrez, 2012). The development of not only the proper documentation but also in the right format, as well as the use of a web simulator online constitutes the final objective of this research.

So let us start with classroom talk and work towards an online lecture or simulation exercise. Traditional sessions are based on paper documentation, an amusing dissertation to explain concepts and interactivity with the teacher. Regarding documentation, the trend has been to develop slide presentations that help both teacher and student to follow the discourse. It seems reasonable to provide the same set of slides for online students but with audio-visual explanations.

If the lecture is audio recorded, the students may also listen to the teacher's explanations while studying. Even a video might be recorded. Usually, both the images and sound are rather boring because they are recorded outside a classroom without students. It would be more appealing to have onsite recording and post-produce the sound and/or the video to match the slides. The result is a more "realistic" and interactive e-learning environment. There are tools like MsProducer that are easy to use to match slides and recorded material. These materials can be provided to students (in the classroom or online) so that they can prepare for or study after lectures.

Most teaching centres currently use virtual learning environments such as WebCT. These platforms are easily loaded with teaching materials in any format, ranging from text documents to slides, including videos and sounds or even questionnaires and assignments. Both onsite and online students access the platform with a password. Teachers' personal web pages might also include a link to these files.

While using web simulators, videoconference is an appropriate tool to coach online and perform experiments. They are likely to be integrated within the virtual campus with a link that enables students to join a session. Therefore, within the virtual campus, the teacher is able to teach online and guide students while handling the

web simulator and conducting experiments. There is also the possibility of developing and including assessments that are activated at different times during an experiment.

The integration of text, sound or video in virtual campuses therefore enables “real” experimental teaching online within traditional virtual learning environments. Links to videoconference tools and web simulators are also liable to be included in virtual campuses. Students prepare for an experiment with “live” lectures and interact online with the teacher while conducting the experiments. Assessment is also online. Web based role-playing in teaching also appears to be possible in traditional virtual campuses.

In sum, what follows is our proposed sequence and explanation of the process required to develop an integrated platform in the virtual campus and then give a successful independent online experimental lecture based on web simulators.

<u>Stages of the process</u>

1. Description of the problem and the experiment: the main task is always to define the real world and the analysis to be performed. A thorough description of the system and the management objectives must be provided, identifying the main output indicators or dependent variables as well as the critical drivers or independent variables.

2. Web simulator selection and development: the next step is to choose the web simulator to be used to model reality. The simulator might already be available on the internet, or the teacher might develop one from scratch.

3. Development of teaching material for classroom activity: the documentation is usually provided in the form of slides or text files. This documentation should include items related to the system under study, to the theoretical background of the analysis and also to the use of the web simulator.

4. Development of the web platform: the virtual campus that is being used by the university or teaching centre must be loaded with the teaching material as well as a link to the web simulator. A subject course must be created to control the students who access the documentation and subsequently participate in the experimental web session.

5. Classroom teaching: a session might then be carried out in the classroom. Explanations about the topic and use of the simulator go first and are recorded. This is followed by the experimental exercise using the simulator.

6. Development of teaching and appraisal e-material: post-production is necessary to develop exquisite materials for e-learning. Videos of the classroom activity should be combined with slides to create specific contents for online teaching. Questionnaires or multiple choice exams are also to be developed to measure the acquisition of knowledge and skills.

7. Development of the web platform: once again, the materials are to be loaded into the virtual campus. It is also good practice to include links to chats and videoconference tools to facilitate the experimental session.

8. Online teaching: the independent e-session is conducted using the web simulator with the help of the videoconference tool.

A complete view of the process applied in the entire experimental e-learning activity is shown in Figure 1.

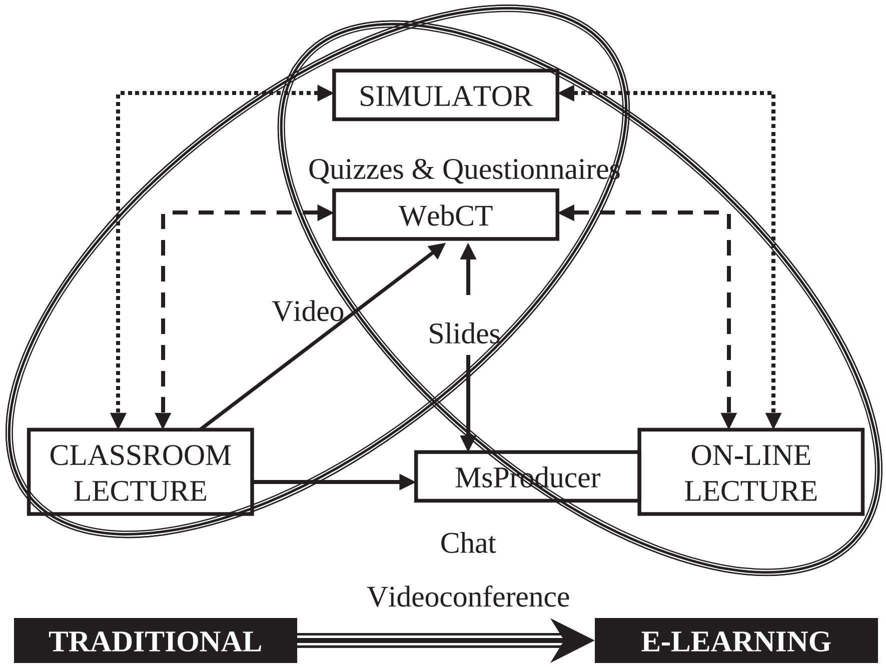

Figure 1: Integration of tools for classroom and online lectures

3. METHOD AND MATERIAL: IMPLEMENTATION FOR CAPACITY AUCTIONS

In order to validate this procedure, a simulator environment was developed to analyze and understand capacity auctions for LNG. The EU directives on the liberalization of the electricity and gas markets seem to drive the sector to the development of auction processes in every stage of the supply chain. As well as the utilities markets currently available for products or commodities, the trend is to develop capacity markets referred to the rights to move the product from producer to consumer. One of the main stages is the offloading of ships that transport LNG into harbors. More precisely, for validation purposes, the goods to be auctioned are the rights for ships to offload LNG.

Our students were enrolled in Business Administration and Economics. The aim is for them to understand auction processes based on economic and managerial decisions, profit generation and firm behavior. The ultimate objective was to reach market equilibriums through the interaction of agents mimicking real life. It is therefore a good opportunity to teach students about auctions via simulation.

Several simulated exercises were formulated as a function of different types of auctions: close bid or time-dependent. The possibility of Monopoly, Oligopoly or Perfect Competition was also contemplated. Furthermore, government regulators were included in some cases, in the form of teacher bidding, to prevent excessive auction prices being passed on to other firms in the production chain or the end consumers.

3.1. Description of the Problem

The offloading system was described to students as follows. A company buys LNG that is transported by ship and must be offloaded at a harbor. Ships or tankers are usually large. The investment in LNG is therefore high and the cost of not offloading at the proper time grows with the delay. The size of the tankers will also force the company to buy just a few offloading rights over a long period of time. So timing is very important and bidding for the proper slots is critical. Therefore, each company manager (student) that is going to participate in the auction and buy offloading rights must learn how to proceed in this situation and design strategies (independent variable) that will allow him/her to maximize profit while maintaining reliability of service (dependent variables). To mimic the real world, it is assumed that competitors should not be large in number, no more than 25.

3.2. Web Simulator

For the simulations, the teachers decided to choose the free software designed and developed by the Experimental Economics Center of Georgia State University: *econport*. This e-learning tool (Cox and Swarthout, 2005), has been used for different economic and managerial fields in education (Hsinchun, Zeng, Kalla, Zan,

Cox & Swarthout, 2003) to explain the mechanism of price determination and market-making, especially in emerging markets like the gas market.

An *econport* module was used as the basis for simulating capacity auctions. In particular, *econport* has one routine that resembles a primary market in which one seller offers several goods to different bidders.

For the experiment, the auctioneer sets the following parameters:

- Number of goods or consecutive periods in which one good is auctioned at a time.
- Value of the goods, which might be individually set by hand or randomly assigned according to a uniform distribution.
- Type of auction from four possibilities:

  a) Sealed-bid auctions: all the bidders simultaneously submit a single bid within the allotted time.
     1. First price: the good is awarded to the bidder who has submitted the highest bid.
     2. Vickrey or second highest price (Vickrey, 1961): the good is awarded to the bidder who has submitted the highest bid, but at the second highest price.

  b) Dynamic: the bids vary over time, which is limited by design.
     3. English or ascending: bids keep rising until the time is over. The good is awarded to the bidder who submitted the last bid.
     4. Dutch or descending: the price keeps falling in a preset clock pattern until one bidder stops the proceedings by accepting and paying the current price.

The auctioneer then posts the experiment on the web and sends instructions to the bidders, including a password. Each bidder can then join the experiment and send a message to the auctioneer with his/her username. Once all the bidders have logged in and showed their intention to participate, the auctioneer starts the simulation.

The bidder must then place a bid if the good is of interest. Each bidder knows the value of the good, the feasible values of bids and the number of competing bidders. After a good is sold, each bidder knows the selling price, but not the name of the buyer. There is also information about performance in terms of profit, calculated as the difference between value and bid. Profit accumulates after each good is sold. The auctioneer also gets information on a summary screen, which includes number of purchases and profits per bidder and the relationship between values and bids. All these values can be recorded.

With all the available options, the *econport* module has to be parameterized to correctly represent capacity auctions. As slots or rights are auctioned, the first decision is to determine the number of goods to be auctioned in each period. There are some markets, mainly commodity markets, that offer all the goods at once, and bids are for a certain number of rights (Capen, Clapp & Campbell, 1971; Iledare, Pulsupher, Olatubi & Mesyan, 2002; Fitzgerald, 2010). Multiple rounds might be held until there is a match between supply and demand. However, in our case, capacity auctions favor one-right-at-a-time auctions due to the importance of offload timing. *econport* enabled us to establish consecutive periods in which one good is individually auctioned.

The second decision is to determine the length of each of the auction periods. To allow for comparison across auction types, the same length should be set for each of them. While the time for sealed bid auctions (high price and Vickrey) is intuitively set, pure English ascending price auctions do not have a time limit other than the one set by the auctioneer after a bid has been provided. Dutch auctions are very different in nature. The time is set by the starting price which is established by the auctioneer as well as the price decrement between calls. If the starting price is high and the decrement is low, auction time might be very long. These two decisions restrict the way in which parameters are set across auction types.

For this experiment, the simulation period was divided into 6 slots or rights, so up to 6 tankers were liable to be offloaded. Each auction period lasted 25 seconds: 5 to read the instructions and prepare the strategy and 20 to participate in the auction and bid. Each experiment was to be tested under the rules of each of the four auction types (4 scenarios per experiment).

3.3. Teaching Material

The first set of slides relates to auctions in general, explaining and comparing the four types. Each one is defined in terms of its procedure, as well as in terms of length of time and feelings of the bidder and the auctioneer. Theoretical strategies are also discussed.

The second set of slides corresponds to an explanation of the LNG market and the need to understand capacity auctions. The capacity auctions that are already under way across Europe are explained so that the students realize that such auctions are implemented in the real world.

Finally, a third set of slides contains information about *econport*, and the way auctions are conducted within this web simulator. Links and passwords are provided, as well as screenshots to favor rapid adjustment to the simulated environment.

3.4. Development of the web platform

Our university uses WebCT as a Virtual Learning Environment. Figure 2 shows three screenshots of the virtual campus. The first is the homepage, only accessible for registered students, which shows the two courses to be followed (classroom and e-session). The second shows the first page of the classroom course. Under contents (contenidos), the three sets of slides are available. A link to *econport* is included in the third set of slides.

3.5. Classroom teaching

A classroom lecture was given to facilitate the development of "realistic" material for e-learning and to motivate their interest (Sansone, Smith, Thoman & MacNamara, 2102). During the first twenty minutes of the classroom lecture, the teacher explained these documents and answered queries about concepts like auction types and their consequences in terms of quantities and prices for auctioneer and participants. A LNG professional then described the status and rules of the Spanish LNG market. Finally, the last 15 minutes were spent explaining how the Experimental Economics Center platform worked and the procedure for all the different types of auction. The classroom activities were video recorded so that they could be incorporated into WebCT. After a break, the experiment was carried out, thus completing the teaching cycle.

3.6. Development of teaching and appraisal e-material

In order to prepare for the experimental e-session, more teaching material is developed. In particular, the recorded classroom activities are post-produced. After that, the slides in raw format are combined and synchronized with the videos so that a "real" class can be studied by the participants without the teacher.

Two sets of questionnaires are also developed. The first is to be completed before the simulation exercise and the second afterwards. The first questionnaire comprises 5 questions (Appendix A) about students' prior knowledge of and participation in online activities in general, and specifically in auctions. The second, 11-item questionnaire (Appendix B) inquires about feelings, strategies and the activity's usefulness for learning and acquiring skills.

Figure 2: WebCT and the classroom activity (a) Main screen of personal WebCT (b) Main screen of classroom activity (c) Links to slides

3.7. Development of the web platform

E-session students have two additional options. Under resources (recursos), they can access the recorded videos as well as a link to the videoconference that also includes a chat. Under tests, there is also access to the questionnaires. Figure 3 shows the screenshots of the platform as shown to the students.

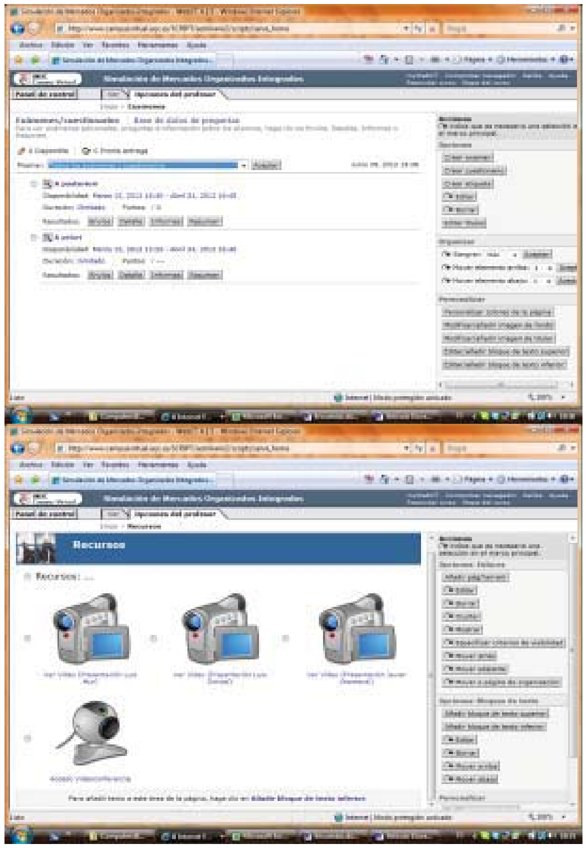

Figure 3: WebCT and the online activity: (a) Screen with links to videos and videoconference (b) Screen with questionnaires

3.8. Online teaching

With the virtual learning environment completely set, it is the proper time to conduct an independent e-experiment. After a short period for the students to get things straight with the videoconference and the web simulator, the experimental simulated exercise can be performed with the same characteristics as the classroom lecture (Smith, Sorensen, Gump, Heindel, Caris & Martinez, 2011).

4. e-EXPERIMENT RESULTS AND DISCUSSION

After the classroom activity that took place on Nov 4th, 2011 with a small group of selected students, the online activity was carried out on March 15th, 2012 with a completely new set of students. The teachers were located in one room at the University and the e-students were spread over the web, in different Spanish cities. The experiment started at 5 p.m. and lasted until 7 p.m. There was first a connection period that began at 4:30 p.m.

Twenty-three students started the online exercise, but only eighteen completed the activity. Five of them did not submit the final questionnaire. Additionally one could not start due to problems related with the browser but stayed connected via the videoconference. The full list of answers to the questionnaire are included in Appendix C and summarized in Table 1. The total number of answers to each question is provided in the "Total" column, with the frequencies for each answer from "a" to "e". An explanation of the answers is also provided in the last column: "++" indicates very positive and "--" very negative, "Y" is "yes" and "N" is "no", while HVED are the initials of each type of auction (Highest price, Vickrey, English and Dutch).

Table 1: Summary of answers to the questionnaire

		Total	a	b	c	d	e	a	b	c	d	e
A PRIORI	Have you previously participated in an on-line academic activity?	23	8	15				Y	N			
	Have you previously participated in an auction?	23	3	20				Y	N			
	Have you previously participated in an on-line auction?	23	2	21				Y	N			
	Did you have theoretical knowledge about auctions before you read the on-line documentation provided?	23	0	0	7	8	8	++	+	0	-	--
	Are you ready to carry out the on-line activity?	23	0	2	13	8	0	++	+	0	-	--
A POSTERIORI	Were you comfortable while participating in the on-line activity?	18	10	8	0	0	0	++	+	0	-	--
	Were you comfortable with the simulator?	18	8	7	2	0	1	++	+	0	-	--
	Were you comfortable with your knowledge about auctions?	18	7	10	1	0	0	++	+	0	-	--
	Were you comfortable with strategy planning and execution during the auctions?	18	4	9	3	2	0	++	+	0	-	--
	What was the degree of fulfillment of your strategic objectives?	17	4	6	5	1	1	++	+	0	-	--
	With which type of auction were you more comfortable?	18	6	2	8	2	0	H	V	E	D	
	Which type of auction seems to be the fairest?	18	5	4	7	2	0	H	V	E	D	
	Was participation in this activity useful?	17	10	6	1	0	0	++	+	0	-	--
	Was the availability of documentation prior to the simulated auction useful for you?	18	9	5	4	0	0	++	+	0	-	--
	Did you gain any new knowledge?	18	7	10	1	0	0	++	+	0	-	--

The research questions were fully addressed: it is feasible to integrate a web simulator into a Virtual Learning Environment with a classroom atmosphere and teach ubiquitously. Moreover, out of the eighteen that answered the questionnaire, nine found the documentation provided very useful and five others useful, while the other four said it was average. Most of them said that previously had no theoretical knowledge about auctions and twenty out of the twenty-three lacked experience with auctions.

To continue our analysis of the interesting results provided by the answers to the questionnaire, the most striking is related to the students' feelings. Most of the answers were positive when referring to comfort. Only the student who had problems with the simulator answered very negatively (--) and the other negative answers (-) refer to strategy, which of course relates to theoretical knowledge about auctions and the frustration of not obtaining the products that they wanted.

The dispersion in the answers about auctions was again consistent with the lack of theoretical knowledge, which cannot be gained with a single set of experiments. The students' personal comments showed their willingness to participate in more exercises, which means that they were comfortable with the tool and perceived experimental teaching as a good way to gain theoretical knowledge. Everyone agreed that the repeated application of the simulation process for each auction was very useful for better understanding the potentiality of the information transmitted and virtual market activities.

The third block of answers rated the experience as useful for knowledge acquisition. The general feeling was that the activity had been a very motivational experience perhaps due to the immediate application of the theoretical concepts and the interaction provided by this technique. Nonetheless, most of the students said that they would have needed more time to learn the basics of the theoretical economic concepts, although they confirmed that appropriate information about the platform's use was provided.

The experiments also showed a potential for studying concepts such as the importance of perfect information as provided by common values, the possibility of monopoly by raising bids and not making a profit, entry barriers created by assigning low values to the same player through one experiment, and technological constraints and advantages, as some computers have better internet connections than others. All these subjects were highlighted by the participants in their feedback.

However, considering the concepts to be learnt, the bids were very different to the theoretical values of the rights because of the general feeling that students preferred to buy offloading rights rather than earn a profit. Students highlighted that their previous profit targets were too optimistic compared with those obtained, showing wishful thinking behavior. It would be appropriate to develop an incentive system other than grades that generates more realistic student involvement, in the sense that they must operate as if they were in the real world. In other words, it is better achieve earn positive profits in the medium-long term than to buy the rights for the "joy of winning" (Cooper & Fang, 2008; Delgado, Schotter, Ozbay & Phelps, 2008).

Finally, it is also important to note that in this research, the interaction between *econport*, WebCT and Microsoft Producer proved to be a simple tool for learning easy general auction concepts but somewhat rigid in two situations, which are: first, when setting rules across periods, as values must be set beforehand, and secondly, when analyzing and comparing results across experiments as post-processing was time consuming. In terms of research, the use of the simulator showed the possibility of designing a full, consistent set of experiments, the results of which could shed new light on how to clear a market by submitting bids.

5. CONCLUSIONS

Integration and implementation of web simulators in an experimental e-learning process has been successfully carried out with 23 online students in relation to a real scenario in which auctions were used to buy offloading rights of LNG, following EU regulations. The experience was very positive so we can conclude that the development of the theoretical framework and the associated platform could be followed to for further experimental e-learning.

Both technical and learning goals were attained. The e-participants claimed that the experiment was highly satisfactory in terms of ease of use and enjoyable learning. Both teachers and students exhibited a high level of satisfaction about the whole e-learning process and the possibility of acquisition of knowledge. It is important to note that technical integration of the platforms fostered the level of complementarities between online and classroom participants. Whereas the former benefited from the new technology and role play actions, the latter gained in the acquisition of a degree of traditional classroom lecture atmosphere because of the video recorded materials. Both of them expressed their intention to participate in other sessions in the future.

However, some evolution is required concerning the technological process. For instance, the existence of server firewalls and non-public IPs may disrupt communications between auctioneer and bidders. The development of a new simulator might help to control and avoid communication problems, especially if larger groups are targeted.

Regarding the role play action, the integration of *econport*, WebCT and Microsoft Producer allowed us to show the strategies that should be followed from the bidder's or auctioneer's point of view, in order to achieve full market equilibriums. Other issues such as the existence of government regulators or the importance of information and technical conditions in the capacity auctions field could also be taught and studied.

In addition, some improvements can be pursued in the theoretical design of the role play in the auctions. Multi-round auctions, entry barriers or security dispositions could be part of a more robust e-learning platform. The detailed design of the "real" case studies will probably require the development of new simulators from scratch so that "real world" specifics can be further addressed.

Therefore, it appears that computers and web technology can help to include experimental teaching in the e-learning process. The web simulation environment must however be improved in order to be more realistic.

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Appendix A: A Priori Questionnaire

Question 1: Have you previously participated in an on-line academic activity?
a. Yes
b. No

Question 2: Have you previously participated in an auction?
a. Yes
b. No

Question 3: Have you previously participated in an on-line auction?
a. Yes
b. No

Question 4: Did you have theoretical knowledge about auctions before you read the on-line documentation provided?
a. Lots
b. Many
c. Some
d. Few
e. None

Question 5: Are you ready to carry out the on-line activity?
a. Definitely Yes
b. Probably Yes
c. Maybe
d. Probably No
e. Definitely No

Appendix B: A Posteriori Questionnaire

Question 1: Were you comfortable while participating in the on-line activity?
a. Very Much
b. Much
c. Some
d. Not much
e. Not at all

Question 2: Were you comfortable with the simulator?
a. Very Much
b. Much
c. Some
d. Not much
e. Not at all

Question 3: Were you comfortable with the knowledge about auctions?
a. Very Much
b. Much
c. Some
d. Not much
e. Not at all

Question 4: Were you comfortable with strategy planning and execution during the auctions?
a. Very Much
b. Much
c. Some
d. Not much
e. Not at all

Question 5: What was the degree of fulfillment of your strategic objectives?
a. Very high
b. High
c. Average
d. Poor
e. None

Question 6: With which type of auction were you more comfortable?
a. Highest price
b. Vickrey
c. English
d. Dutch

Question 7: Which type of auction is the fairest?
a. Highest price
b. Vickrey
c. English
d. Dutch

Question 8: Was participation in this activity useful?
a. Very Much
b. Much
c. Some
d. Not much
e. Not at all

Question 9: Was the availability of documentation prior to the simulated auction useful for you?
a. Very Much
b. Much

c. Some
d. Not much
e. Not at all

Question 10: Did you gain any new knowledge?
a. Lots
b. Many
c. Average
d. Few
e. None

Question 11: Are you ready to carry out an on-line activity?
a. Definitively Yes
b. Probably Yes
c. Maybe
d. Probably No
e. Definitively No

APPENDIX C: Questionnaire results

	STUDENT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
A PRIORI	Have you previously participated in an on-line academic activity?	b	b	b	a	b	b	b	b	a	b	a	b	a	a	a	a	b	a	b	b	b	b	b
	Have you previously participated in an auction?	b	b	b	b	b	b	a	b	b	b	b	a	b	b	b	b	b	b	a	b	b	b	b
	Have you previously participated in an on-line auction?	b	b	b	b	b	b	a	b	b	b	b	b	b	b	b	b	b	b	a	b	b	b	b
	Did you have theoretical knowledge about auctions before you read the	c	d	d	e	e	e	c	d	e	c	d	d	e	d	c	e	d	e	d	e	c	c	c
	Are you ready to carry out the on-line activity?	c	c	d	c	b	c	c	d	d	c	c	c	d	c	c	c	b	d	c	d	c	d	d
A POSTERIOR	Were you comfortable while participating in the on-line activity?		a		a	a	a	b	b	b	b	b		a	a	b	a	a	b	a		b		a
	Were you comfortable with the simulator?		a		a	a	b	b	c	b	e	b		a	a	b	b	a	c	a		b		a
	Were you comfortable with the knowledge about auctions?		b		a	a	b	b	a	c	b	b		b	b	b	b	a	b	a		a		a
	Were you comfortable with strategy planning and execution during the		b		a	a	b	b	d	b	c	a		b	c	b	a	c	d	b		b		b
	What was the degree of fulfillment of your strategic objectives?		b		b	a	a	a	0	c	e	b		c	c	c	a	c	d	b		b		b
	With which type of auction were you more comfortable?		a		d	a	c	c	c	c	c	b		d	c	c	c	a	a	a		b		a
	Which type of auction seems to be the fairest?		b		a	c	c	c	c	c	b	c		a	c	d	b	a	a	a		d		b
	Was participation in this activity useful?		a		a	a	b	b	b	a	c	b		b	a	a	a	a	a	b		a		
	Was the availability of documentation prior to the simulated auction useful		a		b	a	c	b	b	a	c	b		c	c	a	a	a	b	a		a		a
	Did you gain any new knowledge?		b		a	a	b	b	b	b	c	a		b	b	a	a	a	a	b		b		b